Service Insights FOR INDEPENDENT SERVICE CENTERS

Genuine



Parts



Jul-Sep 2011

THE 2011 CAMARO CONVERTIBLE

More power, better performance from the 6.2L V-8 paired with a six-speed transmission.

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- > GM powertrain components . . . OE quality, value is obvious
- > Help and resources available for reprogramming TCMs
- > Visit ATRA and showcased GM transmissions
- > New "modular" training clinics debut
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GM OE Service Parts Update

Getting Specific

GM makes a case for the top quality and value of competitively priced OE Service parts.

Words like "better," "superior," and "a cut above" are typically used to describe original equipment parts. And for good reason. OE parts are the real thing. Engineered for the application by the same company that designed the vehicle, they should perform better.

But exactly why and how are they superior?

GM has answered those questions directly with documentation on specific advantages that some OE Service parts (both GM and ACDelco brands) have over aftermarket offerings. One quality shared by all GM OE Service parts is a design based on the evaluation of real-world product failures by GM Engineering and rigorous durability testing.

In addition to the distinct design and durability advantages of GM OE Service parts, GM has also made the parts price competitive. Dealer-led competitive initiatives and programs such as overPOWER the Competition are convincing Independent Service Centers (ISCs) and vehicle owners that they are better served by sticking with OE Service parts.

For hard evidence, take a look at what GM is saying about the specific comparative value of a few engine and transmission components:

 Heat Treated Sun Shell Kit for 4L60E, 4L65E and **4L70E transmissions:** Side-by-side spline wear durability tests showed the OE Service part remained functional after 6 million cycles, while the aftermarket product failed



after about 700,000 cycles. The reason: the heat-treated teeth on the OE Service collar stood up to wear because an induction hardening process is used. The aftermarket collar failed much quicker because the teeth became worn and non-functional.

OE Service Heat Treated Sun Shell, part number 24228345, before and after the durability test. The OES Service part remained functional after 6 million cycles.

Before the durability



After 6 million cycles. Teeth on the heat-treated collar are still intact and the part remains functional.

- Engine Oil Cooler Lines: With pressurized lines, form, fit and function are key. GM OE Service parts are pre-bent to OE specifications, and thus don't have to be modified like aftermarket versions. They have proper connections to guard against leaks and corrosion, use specified materials for proper shielding and can incorporate updates and upgrades.
- 4WD Actuator (Encoder) Motors: The GM OE Service part is validated to perform with GM 4WD transfer case systems and can be readily updated and upgraded. Encoder sensors are available separately on many models. Lowerpriced aftermarket versions

have developed a reputation for premature failure, according to a recent issue of *Transmission*

Digest magazine.

Up and down the long list of GM engine and transmission components, the story line is the same. GM OE Service parts are designed and built to

exacting specifications, and tests bear out their superiority. Why would you settle for anything less?



Repair Industry News & Updates

GM TRANSMISSIONS

Present and Future — on tap for ATRA show



Transmission specialists have a range of options to meet customer needs today, and that full slate will be on display at the Automatic Transmission Rebuilders Association show in Las Vegas in October.

But if you're a shop with a big share of GM business, a stop at the GM Powertrain booth could leave you more time to do the fun stuff a show offers.

In addition to showcasing cutaways of six-speed transmissions and drive units used in hybrid vehicles like the Chevrolet Volt, GM Powertrain will be talking up its transmission component parts, its unbeatable warranty on remanufactured transmissions and the outstanding value that GM original equipment parts offer.

The overarching message at the show, says Chris Thomas, product development manager for transmissions for GM Customer Care and Aftersales, will be that GM transmission solutions are hard to beat.

"We'll be bringing the message to shop owners and techs that we have a strong nationwide, 3-year, 100,000-mile warranty on plug-and-play reman transmissions, and that we have a full range of component parts for rebuilding jobs, some 300 of which are part of our overPOWER the Competition pricing program," Thomas says.

2011 Voltec Drive Unit 4ET50

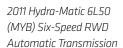
Even though reman jobs are growing more popular, Thomas says GM continues to support rebuilders. Information on the overPOWER program that prices GM OE Service parts to compete with market parts will be emphasized, he says

aftermarket parts will be emphasized, he says.

GM will also use the ATRA opportunity to talk about the future of transmissions, and how repair specialists will be affected. In displaying the drive unit used in the Volt, GM will be looking to better acquaint attendees with the drive train technologies they're likely to see more of in the future.

"This is another new age in transmissions coming around, similar to the changes that swept the industry when automatic transmissions were introduced," Thomas says. "It's important for forward-leaning transmission specialists to take advantage of every opportunity to learn more about this new technology."

The ATRA show will be held at the Hilton Hotel in Las Vegas Oct. 27-31. (MKA) for Chevrolet Volt will be staged alongside the Automotive Parts Remanufacturers Association (APRA) expo.



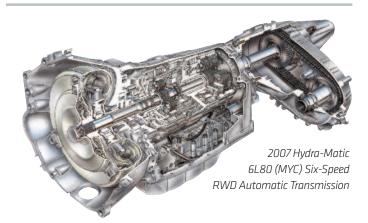
The Technical Side

Many resources available to help with reprogramming **TCMs**

In order to complete the R&R (Removal & Replacement) process for a transmission that has a programmable Transmission Control Module (TCM), technicians will need to program the TCM for the specific vehicle being serviced. There may also be a need to complete learn functions as well as program other control modules.

"This is an important issue for technicians because they are now servicing six-speeds that are coming out of new car warranty."

> **Chris J. Thomas**, product development manager for transmissions, GM Customer Care and Aftersales



Resources and Tools Required

GM Service Information (SI) Online

The R&R service procedure for the specific year make and model detailing necessary calibration programming and setup/learn procedures is available through ACDelco Techconnect at www.acdelcotechconnect.com/html/ tss_tech_esi.jsp. Various types of subscriptions are available based on individual shop requirements.

Service Programming System (SPS)

Calibration reprogramming is performed using a combination of the Service Programming Systems (SPS) application and the MDI vehicle communication interface, Tech 2 scan tool, or third party J2534 compliant vehicle communication interface. SPS is a web-based application.



Multiple Diagnostic Interface (MDI)

Diagnostics/ Setup/DTCs

Depending on the vehicle, diagnostic procedures and setup procedures are performed with one of two solutions:

Global Diagnostic Systems 2 (GDS2) and Multiple Diagnostic Interface (MDI)

are used for diagnostic and setup procedures of the following vehicles.

GDS2 is a webbased application.

2010 - Forward Chevrolet Camaro Chevrolet Equinox Chevrolet Cruze Chevrolet Volt Buick LaCrosse Cadillac SRX GMC Terrain **Buick Regal**

Tech 2 supports: 1992 to 2012

All other GM makes/models

Note: Third party aftermarket diagnostic tools may support certain diagnostic and setup procedures. Contact your tool manufacturer for details and support.

The Tech 2 scan tool and MDI vehicle communication interface can be purchased through approved resellers such as www.boschdiagnostics.com or www.gmdesolutions.com

> Courtesy of Mike Waszczenko, brand quality manager, **GM Customer Care and Aftersales**

Terh2

Scan Tool

The Technical Side (cont'd.)

CHEVROLETCAMAROCONVERTIBLE

The segment-leading Chevrolet Camaro opens a new chapter with the 2011 Camaro convertible. A combination designed to deliver sports coupe-like driving fun and precise quality.

L99 6.2L V-8 VVT for the

Two 6.2L V-8 engines are offered in Camaro SS models, including the L99 on automatic-equipped vehicles and the LS3 on manual-equipped models. Both engines are derived from the LS3 that debuted on the 2008 Corvette, with an aluminum block (with cast iron cylinder liners) and aluminum

cylinder heads. Horsepower for the L99 is 400 (298 kW) and torque is 410 lb.-ft. (556 Nm). The LS3 develops 426 horsepower (318 kW) and 420 lb.-ft. (569 Nm).

All Camaro
models can be
equipped with
either a sixspeed manual
or six-speed
automatic
transmission.
The Aisin AY6
six-speed manual is
standard with the 3.6L engine,

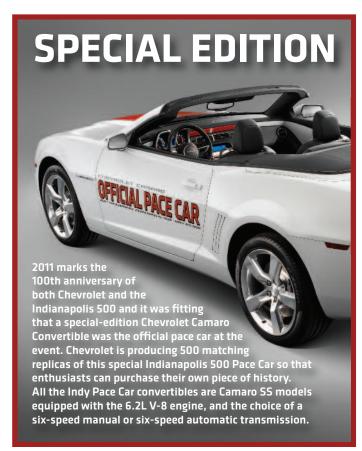
2011 Six-Speed

RWD Automatic
Transmission (6L80) for
the Chevrolet Camaro

Chevrolet Camaro SS

automatic is optional. A Tremec TR 6060 six-speed manual is standard on the SS, and the Hydra-Matic 6L80 six-speed automatic is optional.

The Camaro convertible's enhanced body structure helps prevent cowl or steering wheel shake, for a strong, confident feel in all driving conditions. The top has a smooth, tailored fit with acoustical foam in the headliner that helps deliver a quiet ride with the top up.



and a Hydra-Matic 6L50 six-speed





TechConnect



The electrification of the automobile has been taking place for years, well before today's hybrid vehicles. More and more electronic systems are becoming commonplace, and as a result, more complicated when it comes to electrical system diagnosis. Did you know that the Adaptive Forward Lighting system on some GM vehicles automatically changes light direction and intensity based on speed, vehicle direction and weather conditions?

Understanding the latest electrical systems and how to diagnose them is the focus of two new ACDelco Instructor-Led Training (ILT) courses that are available at local training centers. The two new courses are Body Electrical: Global Diagnostics, S-EL06-13.01ILT, and Advanced Body Electrical System Diagnosis, S-EL06-14.01ILT.

Body Electrical: Global Diagnostics – S-EL06-13.01ILT

Body Electrical: Global Diagnostics covers various electrical faults found on electronic module networking, intermittent electrical faults, and the proper meter use – all designed to help technicians improve their diagnostics skills. In addition, it reviews the serial data architecture of the new GM Global Architecture (Global A) system.

In the course, technicians will:

- Diagnose electrical circuits using a Digital Multimeter (DMM)
- Review AC voltage circuits in hybrid vehicles
- Perform the ground credibility test and other electrical tests
- Identify serial data circuits
- Learn how to use power moding in module diagnostics
- Review terminal fretting and its effect on electrical circuits

Circuit Testing

One testing procedure highlighted in the course covers testing circuit functions in sequence until a fault is detected. Knowing how the testing procedure works enables technicians to apply the same knowledge to any version of a given circuit type. There are nine circuit functions to test:

- 1. Ground circuits
- 2. Low reference circuits
- 3. Battery positive (B+) circuits
- 4. Ignition circuits
- 5. AC voltage circuits
- 6. Reference voltage circuits

- 7. Input signal circuits
- 8. Output control circuits
- 9. Serial data circuits

Ground circuits, for example, are becoming more important to proper

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Outside Air Temperature Display Operation

The outside air temperature is displayed on the Driver Information Center, radio or rear view mirror in a number of GM vehicles. There may be some confusion about the operation of the display and how quickly it updates ambient temperature. Depending on several factors, the temperature may not be updated immediately and owners may feel that the display is inaccurate at times.

As an example, here's a look at the operation of the outside air temperature display on several GM small cars from recent model years (2004-2010 Chevrolet Malibu; 2005-2010 Chevrolet Cobalt and Pontiac G6; 2006-2011 Chevrolet HHR; and 2007-2010 Saturn AURA).

The ambient air temperature sensor is a variable resistor interfaced to the Body Control Module (BCM). The ambient air temperature sensor is a 2-wire negative temperature coefficient thermistor.

The BCM applies 5 volts to an internal input resistor connected to the signal circuit of the ambient air temperature sensor. The BCM also provides the ground to the ambient air temperature sensor through the low reference circuit. When the ambient air temperature is cold, the sensor resistance is high and the signal voltage is high. When the ambient air temperature is hot, the sensor resistance is low and the voltage signal is low. The BCM provides the logic for reading the ambient air temperature sensor, filtering the data and transmitting the information via the serial data circuit to the outside temperature display. The outside air temperature algorithm uses three pieces of information: outside air temperature

> data, vehicle speed, and the time the engine was turned off.

The main source of variation between actual outside temperature and the reading inside the vehicle is at low vehicle speed and stopped conditions. At higher speeds, when more airflow is moving through the front of the vehicle, a more accurate indication of actual air temperature

the variable airflow across the sensor is provided.

When the engine is first started, the algorithm looks at how long the engine was off and if the outside temperature is lower than the last reading taken during the previous ignition cycle. From this information, it's determined if a new outside temperature reading should be taken.

If the engine was off long enough or the current outside air temperature is cooler than the stored value, a new outside temperature reading is taken and displayed. If the engine was not off long enough or the current outside air temperature is higher than the stored value from the previous ignition cycle, the last stored value of outside air temperature taken will be displayed.

The outside air temperature will continue to be updated every second as long as the outside air temperature is the same or cooler than the previous reading. Once the new outside air temperature reading exceeds the previous temperature and the vehicle is traveling less than 18 mph (29 km/h), the displayed outside air temperature will remain at its last value. Once the vehicle speed exceeds 18 mph. the displayed outside air temperature will be updated. If the speed drops below 18 mph, the outside air temperature will freeze at its last value.

When using a scan tool during diagnosis, it is possible that the temperature reading on the scan tool will differ from the temperature displayed on the DIC/radio without there being a problem with the vehicle. The DIC/Radio only displays the reading being sent from the BCM.

- Thanks to Ernest Haller

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ACDelco 360 represents our mission to look at our businesses at every possible angle to provide value and assistance to our distributors and their customers as well as offer a full circle of support with programs, tools, training and marketing focused on enhancing and growing our partnership successfully.

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ACDelco service tips are intended for use by professional technicians, not a "do-it-yourselfer." They are written to inform those technicians of conditions that may occur on some vehicles, or to provide information that could assist in the proper service of a vehicle. Properly trained technicians have the equipment, tools, safety instructions and know-how to do a job properly and safely. If a condition is described, it cannot be assumed that the information applies to all vehicles or that all vehicles will have that condition.

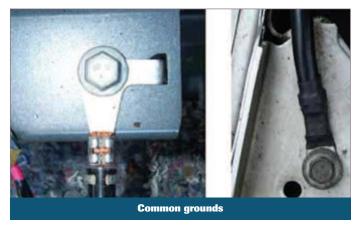
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New ACDelco Electrical System Diagnosis Training

- continued from page 1



diagnosis as more and more electrical components share a common ground. Statistically, ground circuits are the most often overlooked when diagnosing electrical concerns.

With Electronic Control Unit-based electrical systems, high resistance in ground wire connections can produce conditions such as cranking difficulties or improper injector triggering.

Intermittent Conditions

Another topic covered in the course, intermittent diagnosis, examines the different types of intermittent fault conditions. These can include terminal fretting and deformation, bussed electrical center terminal contact, and hot and cold temperature sensitivity.

Terminal deformation can occur when probing the mating side of the connector terminal without the proper adapter, which results in poor terminal contact and causes an open or intermittently open circuit. Use the proper terminal probe adapter from a terminal probe test kit when checking terminals.

Advanced Body Electrical System Diagnosis – S-EL06-14.01ILT

Advanced Body Electrical System Diagnosis focuses on various procedures and diagnostics for Body Control Module (BCM) and non-BCM body electrical systems, such as power windows, power locks and lighting as well as keyless entry, RainSense wipers and Ultrasonic Rear Parking Assist.

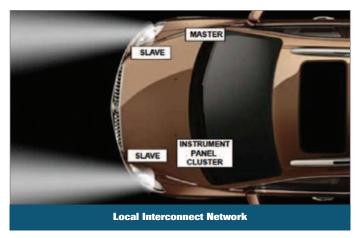
Participants in the course will cover:

- Various communication networks
- Electrical grounds and voltage circuits
- Communication networks
- Global Service Information
- Power window and sunroof circuits
- Keyless entry systems and locking functions
- Lighting operation
- Identify BCM starting system circuitry
- Review the radio theft lock system and active noise cancellation

Networks

The communication networks highlighted in the course include GMLAN, local interconnect network, CAN graphical interface, class 2, UART and the new Global Architecture.

Taking a closer look at the Local Interconnect Network (LIN), technicians will learn that this network bus transmits serial data over a single wire network circuit bus between a primary control module and other control modules within a particular subsystem. The LIN bus is not exposed t the rest of the vehicle's main communication bus. LIN slaves communicate only to the master module for the network, not to other control modules on the vehicle.



The course also covers the operation of a number of circuits for various body components. One example reviews the power door lock circuits, including the master/slave data transmission and free-flow data transmission.

Free-Flow Communication

On some vehicles, the power door lock system may include the Driver Door Switch, Passenger Door Switch, Body Control Module, Driver Information Center, Rear Door Lock/Unlock Relay and the reversible door lock actuators in each door. The modules that activate the power lock motors are the driver door lock actuator, passenger door lock actuator and the Body Control Module (rear door lock actuators).

Operation can be controlled by several actions, which the modules are looking for at all times. If the front door lock switch provides direct input to the driver door lock actuator, a LAN message is sent that indicates the door lock switch position. The module that activates the power door lock motor receives the LAN message and activates the motor in the appropriate direction.

Learn More

In addition to the new electrical system diagnosis courses, ACDelco offers on-demand, online, Web-based courses, instructor-led Virtual Classroom Training courses and a variety of other instructor-led, hands-on courses at training centers around the country. To review the latest training courses available, log in to the ACDelco Learning Management System (LMS) at www.acdelcotraining.com.

- Thanks to Rick Balabon

New Compressed Natural Gas-Powered Chevy Express and GMC Savana

GM is introducing a dedicated compressed natural gas (CNG) system available on full-size Express and Savana cargo vans for fleet use. The CNG option will be available on 3/4 ton, 135-inch wheelbase and 1 ton, 135-inch wheelbase models.

This new CNG option adds to GM's position as an alternative fuels leader. From 1997 to 2007, GM built more than 23,800 CNG or liquefied petroleum gas (LPG) vehicles. Chevrolet and GMC are the only brands to offer a one-source CNG option on vans for fleet customers.

CNG 6.0L **V8 Engine**

The CNG vans are equipped with a Vortec 6.0L V8 (RPO LC8). It maintains the same horsepower (323 hp @ 4.600 rpm) and torque (373 lb.-ft. @ 4.400 rpm) rating as the 6.0L V8 gasoline engine.



Vortec 6.0L V8

Enhancements made to the engine to run on CNG include:

- Hardened engine components for higher wear resistance and durability required in the gaseous fuel system
 - Exhaust valve materials resist higher temperatures and the corrosive nature of propane and natural gas
 - Intake and exhaust valves feature a special insert that ensures an excellent seal between the valve and valve seat
- Dedicated gaseous fuel injection and engine control module
- Engine performance designed to meet Environmental Protection Agency (EPA) and California Air Resources Board (CARB) emission certification requirements

Fuel System

The CNG fuel system consists of:

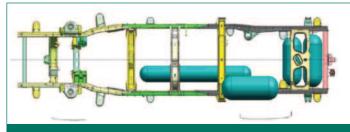
- Four CNG fuel tanks
- CNG fuel tank pressure relief device (PRD)
- CNG fill receptacle and fill line
- CNG fuel tank high pressure lock-off (HPL) solenoid valves
- CNG fuel tank pressure (FTP) sensor
- CNG fuel lines
- CNG 1/4 turn isolation valve
- · CNG fuel filter
- CNG high pressure regulator (HPR)

The CNG fuel system has four tanks with a 23 gasoline gallon equivalent (GGE) capacity. The first tank (6.4 GGE) is located under the center of the vehicle in place of the regular fuel tank. There are two tanks (4.9 GGE and 4.5 GGE) mounted where the spare tire normally is located at the rear of the vehicle. The fourth tank (7.2 GGE) is mounted on the cargo floor in an enclosure, inboard of the left rear wheelhouse.

The fuel storage system provides fuel system corrosion resistance and fuel system integrity that exceed Federal Motor Vehicle Standards. Federal regulations require that the fuel tanks and brackets be inspected every three years or 36,000 miles (60,000 km), whichever occurs first. The service life of the type 1 CNG fuel tanks is 15 years from the date of manufacture, after which, they must be removed from service.

There are four externally mounted pressure relief devices (PRD). Two are equipped with a thermally-activated PRD, one with a combination temperature and pressure valve, and one with a pressure operated burst disc. The burst disc activates when CNG tank pressure becomes too high for safe operation (approximately 5,400 psig).

All external PRDs are connected to fuel storage pressure and cannot be isolated from the high pressure system. Service should not be attempted on these devices or connecting tubing/hoses unless it's absolutely certain that the system is completely empty of CNG fuel.



Four CNG tanks have a 23 GGE capacity.

The CNG fuel lines consist of different fuel line types based on the working pressure and vehicle interface requirements. The high pressure and low pressure CNG fuel lines and hoses are a combination of stainless steel tubing and stainless steel jacketed PTFE (polytetrafluoroethylene). All connections between lines and components are sealed by O-rings specifically designed for CNG operation.

The high pressure CNG fuel system is equipped with a manually operated 1/4 turn isolation valve. The valve is located forward of the rear wheel on the driver's side of the vehicle atthe inboard side of the LH frame rail. The valve can isolate the high pressure side of the fuel system for some service procedures. If the valve is inadvertently left in the Off position, the vehicle will not operate.

The CNG fuel filter, a high pressure coalescing media filter, is located forward of the CNG 1/4 turn isolation valve. It requires periodic service intervals.

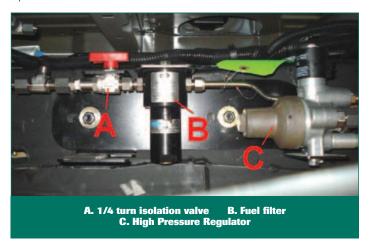
Fuel flow begins when the ignition is cycled and the high pressure lock-off (HPL) and the high pressure regulator (HPR) solenoids open. The HPR is supplied with fuel at pressures up

New Compressed Natural Gas-Powered Chevy Express and GMC Savana - continued from page 4

to 3,600 psig (pound-force per square inch gauge), or 24,821 kPa (kilopascal), at 70°F (21°C). The outlet pressure is regulated to 90-110 psig and delivered through the low pressure lines to the fuel rail and CNG injectors.

The CNG fuel injectors are installed in the base vehicle fuel rail and require spacers between the injector and manifold injector boss.

The ECM controls fuel delivery in the same manner as a gasoline vehicle. The CNG fuel system also features the same powertrain diagnostics and use of the Tech 2 scan tool as a gasoline engine. There are not any new Diagnostic Trouble Codes. Follow the standard repair protocol as with a gasoline vehicle. Refer to the appropriate GM Service Information for specific CNG information.



When the fuel supply system needs to be opened, the pressure in the lines must be relieved before attempting repairs. Refer to the Service Information for the low-pressure-side and high-pressure-side relief procedures.

Refueling

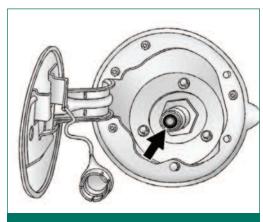
With an estimated mpg of 11 city/16 highway, the four tank design with a 23 GGE capacity provides a range of approximately 250 to 360 miles. The system is designed to be filled at a 3,600 psi (24,800 kPa) station (yellow handle on fill nozzle). It can be filled at a 3,000 psi (20,684 kPa) station (blue handle on fill nozzle), but this will result in a reduced range and a fuel gauge reading of approximately 7/8 full.

The CNG fill receptacle is a NGV1 profile and mates to any NGV1 fill dispenser valve. The fill dispenser seals to the receptacle with an O-ring. Replace the O-ring in the fill receptacle before refueling if it is damaged or missing;

otherwise, natural gas can leak while refueling. The vehicle is shipped with three replacement O-rings in the storage bin on the engine cover.

It should take about 6-8 minutes to fill the fuel tanks at a fuel station for natural gas vehicles. Refueling will stop automatically when the tanks are full.

quantity is affected by changes in fuel temperature and fuel pressure. When refueling in cold ambient conditions, the fuel gauge may not display FULL even though the temperature-compensated refueling



CNG fill receptacle sealing O-ring

event produces a temperature-compensated FULL condition. This is due to commercial refueling station output regulated by a temperature vs. pressure strategy to prevent the vehicle from becoming over-pressurized if relocated to a warmer ambient location after refueling.

Operating Tips

The extra hardware needed for the CNG system adds approximately 800 lbs. to the weight of the vehicle. This additional mass reduces the payload capacity. This should be noted when loading the vehicle. The G23405 model (3/4 ton) has a payload capacity of 2,409 lbs. and the G33405 model (1 ton) has a payload capacity of 3,374 lbs.

Extreme cold weather (below -4°F, -20°C) may make it harder to start the engine. If the vehicle will be driven regularly in cold temperatures, it will be necessary to use the standard engine block heater.

Routine maintenance schedules (fluids, filters, etc.) for the CNG vans are designed to follow the original specifications for the gasoline-fueled vans. The Owner Manual lists the recommended maintenance service intervals and fluid specifications.

- Thanks to Chris Graham

New Heavy-Duty Cooling System Cleaner

A new heavy-duty cooling system cleaner is now available from ACDelco that is safe for removing rust, scale and deposits, including silicate gel, from the cooling system quickly and effectively. This product contains a detergent that removes oil and grease along with a

corrosion inhibitor to reduce corrosion of engine metals during the cleaning process.

The heavy-duty cooling system cleaner, part number is 10-5037, is available in a package of six 16-ounce

containers. Contact your DDG or local ACDelco representative to order.

Refer to ACDelco Bulletin 11D-032 for more information.

- Thanks to Mike DeSander

Timing the High Feature V6 Engine

The following GM models offer the available high feature 3.6L V6 engine (RPO LY7, LLT), 2.8L V6 engine (RPO LP1) or 3.0L V6 engine (RPO LF1, LFW): 2007-2011 GMC Acadia, Buick Lacrosse, Cadillac CTS, SRX and STS; 2007-2009 Pontiac G6 and Saturn AURA; 2007-2010 Saturn OUTLOOK; 2008-2009 Pontiac Torrent; 2008-2011 Buick Enclave, Chevrolet Malibu and Equinox; 2008-2010 Saturn VUE; 2010-2011 Chevrolet Camaro; and 2011 Chevrolet Traverse.

The high feature V6 engine family features a camshaft drive system that consists of a primary timing drive chain driven by the crankshaft sprocket. The primary timing drive chain drives two intermediate drive shaft sprockets. Each intermediate drive shaft sprocket drives separate secondary timing drive chains, which drive the respective cylinder head's intake and exhaust camshaft position actuators.

The following supplemental information may be helpful when timing the high feature V6. Refer to the appropriate Service Information for complete timing procedure information.

Keep these items in mind before beginning the timing procedure:

- In a front-wheel-drive vehicle, it may be easier to remove the engine before beginning.
- When removing the front cover, be sure to remove the belt tensioner and all the bolts. Damage may occur to the block if this procedure is not followed.
- When removing the front cover, do not pry against or strike the cam actuators. This will cause damage to the reluctor or actuator.
- Intake cam actuators have marks on them for the Right Bank (R) and the Left Bank (L). They must be positioned respectively.
- Be sure to note the orientation of the injector wiring harness. The harness with connector should come out on the front side of the engine. If installed backwards it will cause misfires and/or fuel trim DTCs.
- 4 screw Delphi and 5 screw Aisin cam actuators are interchangeable, but will require the correct shim behind them when applicable. 4 screw Delphi actuators use a 0.043 in. shim and the 5 screw Aisin actuators use a 0.063 in. shim.

Stage One Timing

To set the timing on a high feature V6 engine, start with the engine in stage one position with tool EN 46105-1, Camshaft Locking Tool, or EN 48383-1, Camshaft Retaining Tool, on the left bank, or bank 2. The circular timing marks on the camshafts should be aligned as shown.

The painted link should be visible through the hole of the intermediate gear for the left secondary chain.



In stage one position, the circular timing marks on the camshafts should be aligned.

Stage one primary chain alignment for the crankshaft and the left intermediate gear is shown below. The intermediate gear has a triangular shaped timing mark that aligns with the painted link and the crankshaft has a dot-to-dot alignment.

The right intermediate gear has a triangular mark that aligns with the painted link.



The intermediate gear has a triangular shaped timing mark that aligns with the painted link and the crankshaft has a dot-to-dot alignment.

Remove EN 46105-1 or 48383-1 from the left bank.

Stage Two Timing

The engine will need to be rotated 115 degrees clockwise for stage two timing. The crankshaft marks should align dot to dot. Tool EN 46105-2 or EN 48383-2 should fit easily on the rear of the cams on the left bank of the engine.



In stage two position, the crankshaft marks should align dot to dot.

EN 48383-3 should be installed on the right bank, or bank 1. The triangular marks should be aligned.

The painted link on the right intermediate shaft should be aligned with the hole in the rear gear.

The left camshafts will be aligned as shown when in stage two timing position.



The left camshafts will be aligned when in stage two timing position.

If there are any concerns in identifying the correct location for the camshafts, check the number stamped in the rear of the camshaft — RI is right intake, RE is right exhaust, LI is left intake and LE is left exhaust.

- Thanks to James Bloss

TECH tips

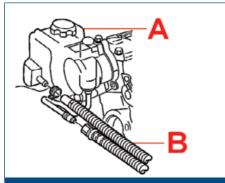
The following technical tips provide repair information about specific conditions on a variety of vehicles. If you have a tough or unusual service repair, the **TSS Technical Assistance Hot Line** can help. Call **1-800-825-5886, prompt #2**, to speak with a technical expert with the latest OEM information.

Power Steering Fluid Restrictor

2003 Chevrolet Cavalier and Pontiac Sunfire with the 2.2L 4-cylinder engine

A rattle or knocking noise noticed when turning the steering wheel while driving slowly over rough roads may be caused by hydraulic noise within the steering rack.

To correct this condition, install a fluid restrictor, part number 22592200, in the power steering return line.



A. Power steering pump
B. Power steering return hose

Remove the power steering return hose from the power steering pump. Install the fluid restrictor in the power steering fluid reservoir return port. The inlet and outlet hoses must not be twisted during installation. Do not bend or distort the inlet or outlet hoses to make installation easier.

After installation, fill and bleed the power steering system.

New Water Pump Bolt Torque Sequence

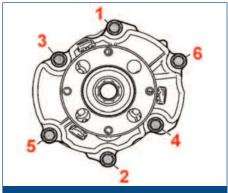
All 2004-2012 GM vehicles equipped with the High Feature V6 engine (2.8L, 3.0L, and 3.6L).

A new water pump bolt torque sequence has been implemented on all High Feature V6 engines to help reduce the potential for water pump gasket leaks.

When installing a water pump, use the following revised water pump bolt torque sequence and procedure:

 Ensure that the engine front cover and water pump are clear of old gasket material.

- Ensure that the water pump mounting bolt holes in the front cover are completely clean and dry.
- 3. Place a new water pump gasket on the water pump.
- 4. Place the water pump in position on the front cover.
- 5. Install the water pump bolts finger tight.



Tighten the water pump bolts in sequence.

- 6. Tighten the water pump bolts in sequence to 12 N·m (106 lb. in.).
- 7. Tighten the water pump bolts a second pass in sequence to 12 N·m (106 lb. in.).

Rear Leaf Spring Clunk Noise

1999-2011 Chevrolet Silverado and GMC Sierra 1500/2500; 2000-2011 Chevrolet Suburban and GMC Yukon XL 2500; 2002-2006 Chevrolet Avalanche 2500; 2003-2011 Chevrolet Express and GMC Savana 2500/3500 vans with 8500 GVWR, 8600 GVWR or 9600

A rear leaf spring slap or clunk noise may be heard when the vehicle is operated over irregular road surfaces. The rear leaf spring tip inserts may have broken apart from wear and fallen out, or may be severely worn or damaged.

Do not disassemble the main pack on the leaf spring or remove the bushing from the spring when diagnosing this condition.

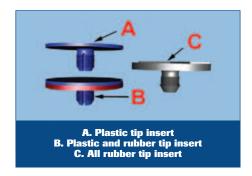
Verify that the rear leaf spring tip inserts are present on the leading and trailing ends of the overload spring (second stage leaf), and inspect the condition of the inserts. If the inserts

are either not present or severely worn or damaged, install new inserts.



On some models, the vehicle may have to be raised to allow the springs to separate enough so the insert can be installed.

Vehicles originally equipped with all plastic or plastic and rubber design tip inserts can be serviced by updated all rubber design inserts.



Diagnostic Assistance

For free technical diagnostic assistance and product information regarding specific ACDelco products, contact these toll-free information hotlines staffed by ASE-certified technicians:

Brakes - 1-888-701-6169 (prompt #1)

Chassis - 1-888-701-6169 (prompt #2)

Clutches - 1-888-725-8625

Lift Supports - 1-800-790-5438

Shocks - 1-877-466-7752

Starters and Alternators – 1-800-228-9672

Steering (Pumps, Rack and Pinion, Gears) – 1-866-833-5567

Wiper Blades - 1-800-810-7096

Training UPDATE

How to Take ACDelco Training

Go to www.acdelcotechconnect.com and click the Training tab to log in to the ACDelco Learning Management System (LMS).

- To enroll in an Instructor-Led
 Training (ILT) course, click the
 Enrollment link or the Instructor-Led
 Courses link to view the catalog
 and select a specific course.
- To enroll in a Virtual Classroom Training (VCT) course, click the Enrollment link or the Virtual Classroom Training Courses link to view the catalog and select a specific course.
- To launch a Web-Based Training (WBT) course, click the Web-Based Courses link to view the catalog and select a specific course.
- To launch a TechAssist (TAS) course, click the TechAssists link to view the catalog and select a specific course.
- To launch a **Simulation (SIM)**, click the Simulations link to view the catalog and select a diagnostic challenge simulation.

Training Spotlight

The following new or updated ACDelco training programs have recently been made available:

S-EL06-11.02ILT – Enhanced Automotive Circuit Diagnosis

This ILT course emphasizes diagnostic skills that are applicable to the complex electrical systems on newer vehicles. It includes a review of GM North American wiring diagrams and the new global format.

S-EP08-81.02ILT – Duramax Diesel Operation and Diagnosis

This ILT course covers the Duramax diesel engine evolution from 2001 to 2011, including an overview of the Duramax features and design changes for all engine applications. The course also covers the engine control management system, the fuel delivery system and the variable geometry turbocharger as well as the features of the aftertreatment system of the new Duramax engines.

Training Schedule

To search for currently scheduled courses, click the Schedule link. Select search terms from the dropdown menus and click the Submit button.

Current Virtual Classroom Training

Course Number	Course Name
FVCT1.09V	How to Use VCT – Recorded
S-AC07-01.01VCT	HVAC System: Components and Lubricants
S-AC07-01.01 VCT-R	HVAC System: Components and Lubricants – Recorded
S-AC07-02.01VCT	HVAC System: Operation and Service Hints
S-AC07-02.01VCT-R	HVAC System: Operation and Service Hints – Recorded
S-AC07-03.01VCT	HVAC System: Flushing, Recovery and Diagnostics
S-AC07-03.01VCT-R	HVAC System: Flushing, Recovery and Diagnostics - Recorded
S-AC07-04.01VCT	HVAC System: Engine Cooling, Controls and Communication
S-AC07-04.01VCT-R	HVAC System: Engine Cooling, Controls and Communication – Recorded
S-EL06-01.01VCT	Electrical Circuit Function and Diagnosis
S-EL06-01.01VCT-R	Electrical Circuit Function and Diagnosis – Recorded
S-EL06-02.01VCT	Testing Electrical Signal and Control Circuits
S-EL06-02.01VCT-R	Testing Electrical Signal and Control Circuits – Recorded
S-EL06-03.01VCT	Serial Data Communication Networks
S-EL06-03.01VCT-R	Serial Data Communication Networks – Recorded
S-EL06-04.01VCT	Communication Network Diagnosis
S-EL06-04.01VCT-R	Communication Network Diagnosis – Recorded
S-EM01-01.01VCT	Camshaft Position Actuator Systems
S-EM01-01.01 VCT-R	Camshaft Position Actuator Systems – Recorded
S-EM01-02.01VCT	Active Fuel Management Operation
S-EM01-02.01VCT-R	Active Fuel Management Operation – Recorded
S-EM01-03.01VCT	Active Fuel Management Diagnosis
S-EM01-03.01VCT-R	Active Fuel Management Diagnosis – Recorded
S-FN00-01.01VCT	How to Use VCT

Current Instructor-Led Training

Course Number	Course Name
S-AC07-02.01 ILT	Automotive Air Conditioning: Advanced Refrigerant System Diagnostics
S-AC07-03.01 ILT	HVAC Control System Operation and Diagnostics
S-BK05-01.01 ILT	Braking Systems
S-BK05-02.01ILT	ABS Operation and Diagnosis
S-EL06-04.02ILT	Network Communication Diagnosis
S-EL06-10.02ILT	Electrical Power Management
S-EL06-11.01 ILT	Automotive Electrical Circuit Diagnosis and Repair
S-EL06-11.02ILT	Enhanced Automotive Circuit Diagnosis
S-EL06-12.01ILT	Hybrid Technology and Service
S-EL06-13.01ILT	Body Electrical: Global Diagnostics
S-EL06-14.01ILT	Advanced Body Control System Electrical Diagnostics
S-EP08-02.01ILT	Engine Performance: Computer Controls and Ignition System Diagnostics
S-EP08-03.01ILT	Engine Performance: Air Induction and Fuel System Diagnostics
S-EP08-04.01ILT	Engine Performance: Fault Monitoring and Emission System Diagnostics
S-EP08-05.01ILT	Engine Performance: Advanced Drivability Diagnostics
S-EP08-81.01 ILT	Duramax 6600: Diesel Engine Performance
S-EP08-81.02ILT	Duramax Diesel Operation and Diagnosis
S-SS04-01.01 ILT	Vibration Correction Diagnostics
S-ST10-01.01 ILT	Supplemental Restraint Systems

TS-PU-0003-11



2011 Camaro . . . from page 6

The Technical Side (cont'd.)

Strong structure

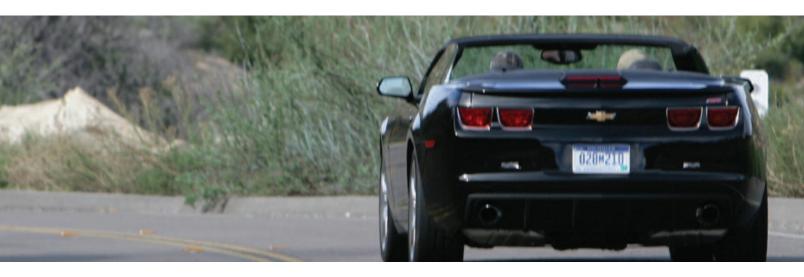
The Camaro's architecture was designed to accommodate a convertible model, which means customers enjoy the fun of top-down cruising with coupelike driving dynamics. Four strategic reinforcements enhance the already-stiff body structure to eliminate the common convertible maladies of cowl and steering wheel shake. They include:

- A tower-to-tower brace under the hood
- A transmission support reinforcement brace
- Underbody tunnel brace
- Front and rear underbody "V" braces.

A telling example of the Camaro convertible's strength is evidenced in its suspension tuning – specifically, the lack of changes between the convertible and coupe models.

"To compensate for the reduced structure of an open car, engineers often will make the suspension softer, making the convertible a boulevard cruiser," said Al Oppenheiser, Camaro chief engineer. "Instead, we took the more difficult, but better path of bolstering structure rather than softening the suspension. We didn't change a strut, bushing or spring rate from the Camaro coupe."

The result is a convertible that preserves nearly all the acceleration, road-holding and performance capabilities of the Camaro coupe.



Even though the 2011 Chevrolet Camaro is a new vehicle, extensive service and repair information resources are a click away at www.gmtechinfo.com -Electronic Service Information. Technicians and shop owners can log on to the site to gain access to subscription services for service procedures and repair manuals. A complete Service Manual is accessible 24/7 through a subscription to the site.

Free collision repair procedures are also available by going to www.genuinegmparts.com.

2011 Chevrolet Camaro – **Intake Manifold Replacement**

Removal Procedure

Note: The intake manifold, throttle body, fuel injection rail and injectors may be removed as an assembly. If not servicing the individual components, remove the intake manifold as a complete assembly.

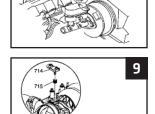
- Remove the engine covers. Refer to Engine Cover Replacement.
- Remove the air cleaner resonator and outlet duct. Refer to Air Cleaner Resonator and Outlet Duct Replacement.

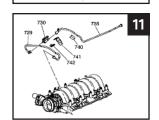
The Technical Side (cont'd.)

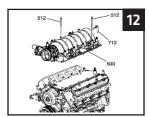
- **B** Disconnect the electrical connector for the fuel injectors.
- **4** Disconnect the electrical connectors from the throttle body.
- **5** Disconnect the fuel feed for the fuel injectors. Refer to Fuel Line Replacement Engine.

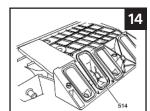
Remove positive crankcase ventilation hose/pipe/tube. Refer to Positive Crankcase Ventilation Hose/Pipe/Tube Replacement.

- **7** Remove the vacuum hose from the brake booster.
- Bisconnect the electrical connector from the manifold absolute pressure (MAP) sensor.
- **9** Remove the MAP sensor (714).
- **10** Remove the grommet (715) from the sensor, as required.
- Remove the evaporative emission (EVAP) clip (740), bolt (742), bracket (741), valve (730) and tubes (729, 735).
- **12** Remove the intake manifold bolts (512) and the fuel rail stop bracket (712).
- **13** Remove the intake manifold (500).
- **14** Remove the intake manifold gaskets (514).
- 15 Discard the intake manifold gaskets.
- 16 If necessary clean and inspect intake manifold. Refer to Intake Manifold Cleaning and Inspection.



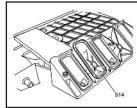






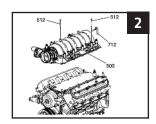
Installation Procedure

Note: DO NOT reuse the intake manifold gaskets. Install NEW intake manifold gaskets.



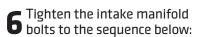
Note:

- The intake manifold, throttle body, fuel injection rail and injectors may be removed as an assembly. If not servicing the individual components, install the intake manifold as a complete assembly.
- DO NOT use the intake manifold gaskets again. Install NEW intake manifold-to-cylinder head aaskets.
- Install NEW intake manifold-to-cylinder head gaskets (514).
- **2** Install the intake manifold (500).
- Apply a 5 mm (0.20 in) band of threadlocker to the threads of the intake manifold bolts (512). Refer to Adhesives, Fluids, Lubricants, and Sealers.

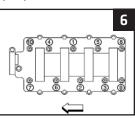


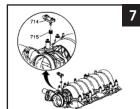
- ⚠ Install the fuel rail stop bracket (712).
- Install the intake manifold bolts (512).

Caution: Refer to Fastener Caution in the Preface section.



- First Pass: Tighten the intake manifold bolts in sequence to 5 N·m (44 lb in).
- Second Pass: Tighten the intake manifold bolts in sequence to 10 N·m (89 lb in).
- Lubricate the MAP sensor grommet (715) with clean engine oil.

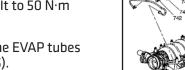




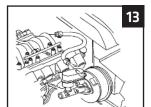
Business of Repairs

Install the MAP sensor (714) and grommet (715).

9 Install the EVAP valve (730), bracket (741) and bolt (742). Tighten the bolt to 50 N·m (37 lb ft).



- Install the EVAP tubes **U** (729, 735).
- Install the fuel rail. Refer to Fuel Rail and Injectors Installation
- **7** Connect the electrical connector for the MAP sensor.
- Install the vacuum hose for the brake booster.
- Connect the electrical connectors (3) for the throttle body.



- Connect the electrical connector (1) for the c connector (1) for the fuel injectors.
- Refill the cooling system. Refer to Cooling System 16 Draining and Filling.
- Install the engine covers. Refer to Engine Cover Replacement.

This example of Intake Manifold Replacement for the **2011 Chevrolet Camaro** is just one of many found in the Service Repair Manual. By following the proper repair procedures, technicians can ensure that each vehicle maintains its solid performance and uncompromised safety features for the life of the vehicle.

WE'VE GOT ALL THE PARTS YOU NEED!

If you're doing a powertrain repair procedure, remember that we've got all the related parts you need electrical, gaskets, motor mounts, belts, hoses – whatever you need to complete the job right, the first time.



New "modular" training clinics for Independent **Service Centers** (ISCs) aim for speedier learning.

As valuable as ongoing education can be, it's sometimes hard not to see it as costly downtime. Dealers recognize that, and some are beginning to roll out a new training clinic format designed to help ISCs use their training time

more productively.

The new quickdelivery format, which also incorporates some new topics not included in the standard training clinic format, lets dealers stage clinics on two distinct topics in one session. The result



is two clinics in roughly two hours, allowing ISCs to get in and out quickly with a sense of having spent their time wisely.

One who did was Leland Prewitt, owner of Prewitt's Automotive, in Savannah, Ga. Prewitt recently attended one of the new modular clinics on advanced variable valve timing, one of several new topics covered in the new modular format. Joined by two of his techs, Prewitt got a better feel for the subject and came away feeling more confident to work on GM vehicles so-equipped.

"Many import lines have had that feature and now GM seems to be taking it a step further," he says. "We found the clinic very informative. The instructor did a good job of covering related issues on emissions and fuel pressure. You don't

Business of Repairs

realize how much these things interact and overlap."

In addition to variable valve timing, other new topics addressed in the modular format include cooling system service tips; hybrid regenerative braking; camshaft variable valve lift and advanced fuel management; homogenous charge compression ignition. The other four topics play off of subject matter covered in the standard clinic format, and include Duramax 6600 diesel engine features 2010/2011 LGH and LML; Duramax 6600 diesel engine updates; fuel system servicing tips; and emission control servicing tips.

Each clinic is structured to give a concise overview of the topic, and is aimed at giving attendees the key information they need to put into action. With advanced variable valve timing, for instance, the goal is to give techs the ability to identify and describe the components and functions of VVT in GM vehicles that include the spline phaser; vane phaser OHC/OHC magnetically controlled and vane phaser cam-in block magnetically controlled systems.

Contact your dealer for additional information on training clinics.

Pacifying the Purists

California Restomodder places his first bet on the E-ROD.

Steve Keefer has heard the whispers, sensed the skepticism. The talk goes something like this: What's a self-described muscle car master doing dabbling in "green" engines, sullying his reputation and the nobility of vintage classics in the process?

Keefer has a ready answer. For one, he says, this is the future. Two, don't be too hasty in passing judgment.

That's how the owner of East Bay Muscle Cars, a Brentwood, Calif., resto-mod shop, defends his developing



interest in GM Performance Parts' emissions-compliant E-ROD LS3 crate engine. To Keefer, the new engine line that marries clean performance with

high performance is going to be the right prescription for many of his more discerning and knowledgeable customers.

"It's the future of hot-rodding, these environmentally conscious engine swaps," he says. "There are a lot of 'dirty' vintage cars out there with original motors, and more regulations on cleaner engines and more emissions testing requirements are coming down the pike. A lot of people balk at smog equipment on these engines, but there's nothing wrong with it."

That explanation played well recently with a 1966

Pontiac GTO owner who became Keefer's first-ever E-ROD installation customer.



Keefer and his five employees swapped the GTO's original 389-cubic-inch V-8 engine for an E-ROD 6.2L LS3 engine, paired with GM's 4L65E, four-speed automatic transmission.

"The installation coincided closely with an E-ROD event at our shop where we had the E-ROD equipped 1955 Chevy on display," Keefer says. "The owner is an environmentally conscious guy who never really trusted the car on the freeway and thought the E-ROD's 430 hp, which is probably underrated, was more than enough for him. I think he was pleasantly surprised with what he ended up with."

The resto-mod project, which entailed maintaining the GTO's factory appearance while modernizing its powertrain, took four months. The engine swap work took about 40 hours and was mostly glitch-free, Keefer says. It involved taking off the entire front end to remove a bulky original A/C unit and stripping down the frame rails. Oil pan, steering rod and exhaust modifications were also needed, as well as some tinkering with a transmission wiring harness.

It's a package that should silence the hard-line skeptics, but Keefer understands the mindset and its frequent rigidity. Through years of doing LS engine upgrades for vintage GM vehicles, he's had to soothe qualms with removing original factory powertrains. Now, after dealing with purists on the vintage side, he's facing down those on the power side. But Keefer is optimistic that engines like the E-ROD will win the day.

"So many people have been used to the old-school big blocks, but once we start talking to them about the



benefits of LS engines we can usually change their mind pretty quick," he says. "There's a lot of natural resistance but once I get guys out on the road with



these engines they can be convinced."

"There was some labor involved in getting the whole transmission and engine package to work together and to get everything hooked up properly," he says. "It took a lot of time to set up the controller to work with our first E-ROD job, but it was well worth it to be able to have the ability to adjust every aspect of the transmission from our laptop."

Other notable elements of the project included a Ron Davis custom radiator, a Rick's Hot Rod Shop custom gas tank, Speed Tech Performance upper and lower control arms, a quick ratio steering box and a Vintage Air a/c unit.

The result is a restored GM legend that delivers an amazing combination of classic appearance with an enviable mix of power, clean operation and performance.

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